

The genus *Chrysopetalum* Ehlers, 1864 (Annelida: Polychaeta: Chrysopetalidae) in the Pacific coast of Panamá

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Abstract.—The family Chrysopetalidae is represented in the Pacific coast of Panamá by three genera: *Bhawania* Schmarda, 1961, *Paleanotus* Schmarda, 1961 and *Chrysopetalum* Ehlers, 1864. Up to now, the latter genus was represented by a single species, *Chrysopetalum occidentale* Johnson, 1897. During a study carried out at the National Park of Coiba (Pacific coast of Panamá), three species of this genus were found: *C. occidentale* and two new species: *C. elegantoides* n. sp. and *C. maculata* n. sp. In this paper the two new species are described and a key for identification is provided. *Chrysopetalum elegantoides* closely resembles the descriptions of *C. elegans* Bush, 1900 and *C. ehlersi* Gravier, 1901. The paleae and neurosetae are very similar to those of *C. elegans*, but specimens from Coiba lack interramal glands like *C. ehlersi*. *Chrysopetalum elegantoides* differs from *C. ehlersi* principally in the tips of paleae and the length of the blades of the neurosetae. *Chrysopetalum maculata* differs from all others within the genus in having a wide body and broad paleae and in the lack of spines. The most similar species is *C. heteropalea* Perkins, 1985; both species lack spines (*sensu* Perkins) and have several symmetrical paleae; but the paleae of the *C. maculata* are ornamented with knobs, lacking the transverse ridges that are typical of *C. heteropalea*. The presence of *C. occidentale* in the area is verified.

Polychaetous annelids are poorly known in the Panamanian Pacific, and only few studies in this area have provided records of these marine animals (Monro 1928a, 1928b, 1933a, 1933b; Fauchald & Reimer 1975; Fauchald 1977a; López et al. 1997). Investigators from the Laboratorio de Invertebrados y Biología Marina of the Universidad Autónoma de Madrid have been working at the National Park of Coiba since 1996 in order to increase the knowledge of the marine fauna in general (San Martín et al. 1997), and the polychaetes in particular (Capa et al. 2001a, 2001b, 2001c, San Martín et al. 1998).

The diversity of genera and species of the family Chrysopetalidae in the Panamanian Pacific appears to be low; only three genera: *Bhawania* Schmarda, 1961, *Paleanotus*

Schmarda, 1961 and *Chrysopetalum* Ehlers, 1864, and four species: *B. goodei* Webster, 1884, *B. riveti* (Gravier, 1908), *P. chrysolepis* Schmarda, 1861 and *C. occidentale* Johnson, 1897, have been reported. The present paper increases the knowledge of this family in the area offering a description of two new species of *Chrysopetalum*, as well as verifies the presence of *C. occidentale*.

The National Park of Coiba (7°10' to 7°53'N and 81°32' to 81°56'W) is a marine-terrestrial area, protected since 1991. It is a set of a large amount of islands and islets, the largest being the one which gives the name to the Park. The study of the fauna and flora of this Park is very important issue for several reasons: the eastern central Pacific has a special biogeographical inter-

est due to its past connection with the present Caribbean (Laverde-Castillo 1986); the lack of human impact; and the few studies carried out in the area.

Material and Methods

The samples were collected during four expeditions carried out between Jun 1996 and Sep 1998. Different substrata were sampled: blocks of dead coral (*Pocillopora* spp.), epibionts from dead gorgonians (*Pacificorgia* sp.) and living oysters (*Hyotisa hyotis*) and coarse sand. Samples were collected in three different ways: the blocks of dead coral *Pocillopora* spp. (approximately 4 kg) were sampled by SCUBA and immediately put into a bag, the blocks were then placed in sea water for 24 h in order to induce the organisms to leave the coral cavities due to short supply of oxygen; the remainder of the organisms were extracted by fragmenting the branched blocks; the polychaetes associated with dead gorgonians and living oysters were sampled by SCUBA, by removing the substrata and scraping off their surfaces; and for sampling the polychaetes in coarse sand, a corer 9.5 cm diameter and 1 liter volume was used, and the sediment was washed through a 0.25 mm gauge mesh sieves.

The samples were fixed in a 10% formaldehyde-seawater solution and preserved in a 70% alcohol solution. For identification a Olympus SZ30 stereomicroscope and Olympus CH30 optical microscope were used. Parapodia from most of the specimens were removed and slide mounts were made in glycerine gel. The drawings were made to scale, with a drawing tube, in a Nikon Optiphot optical microscope equipped with interference contrast optics (Nomarsky). Scanning electron micrographs (SEM) were made using standard procedure. The specimens in 70% alcohol were introduced gradually in solutions more concentrated in acetone. The specimens were critical-point dried in carbon dioxide, coated with gold and viewed through a SEM Phillips XL-30

system, in the SEM unit at the Universidad Autonoma de Madrid. The specimens are deposited in the Museo Nacional de Ciencias Naturales de Madrid (MNCNM), Spain.

The sample sites, co-ordinates and habitats are provided in Table 1. In 14 samples studied, a total of 65 specimens of Chrysopetalids were identified belonging to only one genus, *Chrysopetalum*, and three species.

Results

Genus *Chrysopetalum* Ehlers, 1864

Type species.—*Chrysopetalum fragile* Ehlers, 1864.

Diagnosis.—Medium in size, up to 65 segments. Prostomium rounded, partially retracted into anterior segments (about posterior margin of the fourth segment), with two pairs of eyes generally in rectangular disposition, anterior pair larger than posterior ones. A pair of elongate ventral palps. Pair of long lateral antennae emerging ventrally on anterior margin of dorsal surface, and short median antenna, fusiform, originating behind anterior eyes. Caruncle attached on posterior dorsal margin of prostomium, smaller than prostomium, sphaeroidal, and reaching the end of fifth setiger. Ventral mouth opening with triangular or rounded cover, extending from anterior margin of fifth segment. Peristomium reduced, only visible as lip covering the mouth. First two segments each with pair of dorsal and ventral cirri, similar to those following segments. First segment asetigerous, second segment only with notosetae. From third segment, parapodia biramous with notopodial paleae (modified notosetae) and compound spinigerous neurosetae on anterior segments, changing to compound falcigerous neurosetae through posterior segments. Dorsal cirri with long cirrophores and long cirrostyles with wide basis and filiform distal part. Ventral cirri shorter, but similar in shape. Dorsum partially covered by flattened paleae, distally serrated, with

Table 1.—Collection sites, coordinates, habitats, depths and weight/volumes of the studied samples.

Sampled substrate	Samples	Coordinates	Station	Depth	Weight/volume
Dead coral samples	CM2FEB97	7°49'N, 81°46'W	Isla de Uvas	3 m	—
Dead coral samples	CM3FEB97	7°41'50"N, 81°38'25"W	Isla del Canal de Afuera	6 m	4000 g
Dead coral samples	CM4FEB97	7°24'20"N, 81°41'W	Ensenada María	3 m	4200 g
Dead coral samples	CM2NOV97	7°38'30"N, 81°41'40"W	Playa Rosario	2.5 m	4100 g
Dead coral samples	CM4NOV97	7°24'20"N, 81°41'W	Ensenada María	5.8 m	4400 g
Dead coral samples	CM5NOV97	7°49'N, 81°46'W	Isla de Uvas	6 m	4000 g
Dead coral samples	CM1SEP98	7°35'30"N, 81°42'30"W	Isla de Granito de Oro	2 m	3000 g
Dead coral samples	CM4SEP98	7°24'20"N, 81°41'W	Ensenada María	2 m	3600 g
Dead coral samples	CM5SEP98	7°38'30"N, 81°41'40"W	Playa Rosario	1.2 m	3900 g
Gorgonian epibionts	CUAL8JUN96	7°38'N, 41°47'10"W	Islote Santa Cruz	11 m	—
<i>Hyotisa hiotis</i> epibionts	CUAL2FEB97	7°36'40"N, 81°49'30"W	Islote San Martín	14 m	—
<i>Hyotisa hiotis</i> epibionts	CUAL5FEB97	7°36'10"N, 81°50'10"W	Punta Cirilo	4–9 m	—
Below rocks	CUAL8FEB97	7°41'50"N, 81°38'25"W	Isla del Canal de Afuera	4–6 m	—
Coarse sand	AR1SEP98	7°39'N, 81°41'40"W	Bajo Mali Rock	10 m	1 liter

internal longitudinal ribs and transverse chambers. Paleae of middle segments forming at least three groups arranged in semi-circular or straight row, covering dorsum, extending from bundles occupying 0.5 to 0.67 of segmental width, serrated on both margins. Some species with an additional row of anterior spines. Middle group paleae consisting of two or three irregular transversely arranged rows of long and slender paleae originated in up to eight developmental centers, median paleae symmetrical, each with up to 12 internal longitudinal ribs, lateral ones with tips asymmetrical, bent toward middle of group. Lateral group paleae consisting of up to 10 more slender, symmetrically tipped, laterally orientated paleae, also with internal ribs. Midline group paleae arranged in longitudinal to slightly oblique row of up to six; each bent medially and posteriorly, shorter, slender than middle group paleae, with almost symmetrical tips. Compound falcigers with blades decreasing in size dorsally to ventrally, unidentate, with hooded tips and serrated margins. Pygidium with pair of anal cirri similar to dorsal cirri (Perkins 1985, San Martín in press).

Chrysopetalum elegantoides new species
Figs. 1, 2

Material examined.—Holotype: CM2NOV97 (MNCN 16.01/8531a), paratypes: CM2FEB97(2) (MNCN 16.01/8352), CM3FEB97(1) (MNCN 16.01/8533), CM4FEB97(21) (MNCN 16.01/8534), CM2NOV97(5) (MNCN 16.01/8531b), CM4NOV97(2) (MNCN 16.01/8535), CM5NOV97(1) (MNCN 16.01/8536), CM1SEP98(6) (MNCN 16.01/8537), CM5SEP98(1) (MNCN 16.01/8539), CUAL8JUN96(1) (MNCN 16.01/8541), CUAL2FEB97(1) (MNCN 16.01/8541), CUAL5FEB97(8) (MNCN 16.01/8543).

Additional material examined.—CM3FEB97(fragments), CM4FEB97(fragments), CUAL8FEB97(fragments).

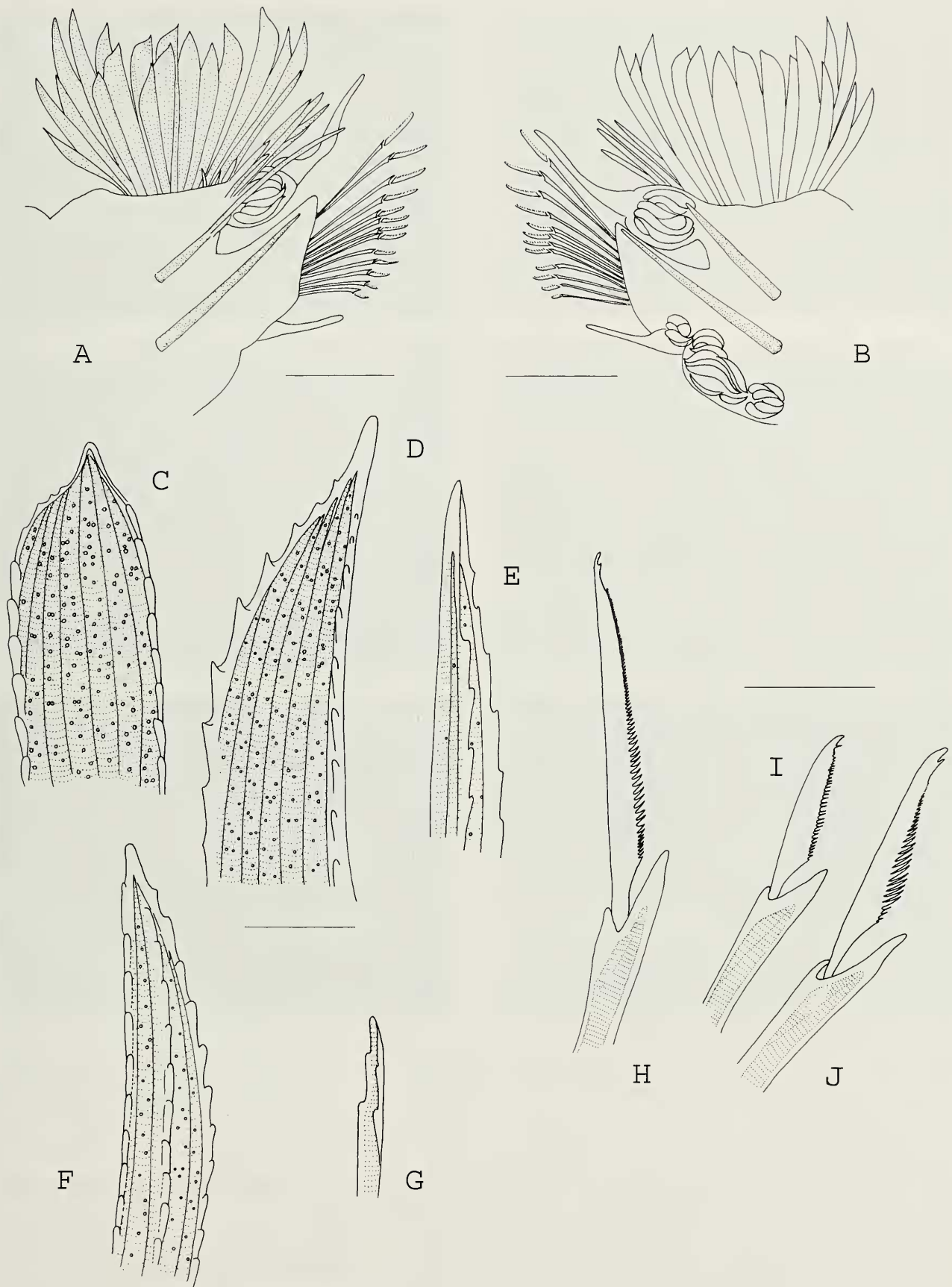


Fig. 1. *Chrysopetalum elegantoides* n. sp. Paratype CM1SEP98. A: Right parapodium, setiger 33, anterior view; B: Same, posterior view; C: Tip of symmetrical palea, middle group; D: Tip of palea, lateral part, middle group; E: Palea, lateral group; F: Palea, midline group; G: Spine, anterior group; H: Upper compound falcigerous neuroseta, middle segments; I: Lower compound falciger; J: Middle compound falciger. Scale A, B: 68.25 μm ; C–J: 20 μm .

Other material examined.—*Chrysopetalum elegans* MNCN16.01/4107, MNCN 16.01/4194, MNCN16.01/4201, MNCN 16.01/4195 from Cuba, loaned by de Museo Nacional de Ciencias Naturales de Madrid. *Chrysopetalum ehlersi* 1941.4.4.238 and A39 from Red Sea, 1969.192 from Kuwait and 1961.8.14 from Mombassa; loaned by the Natural History Museum, London and the Museum National d'Histoire Naturelle de Paris.

Description.—Only two complete specimens (the holotype and one paratype in sample CUAL3FEB97). Holotype 8 mm long, 0.6 mm wide with 58 segments. Complete paratype 6 mm long, 0.5 mm wide, with 37 segments. Prostomium oval, slightly longer than wide. Some specimens having three pairs of eyes, with two posterior pairs slightly superimposed, anterior pair sometimes very close to each other but also separated in other specimens. Caruncle smaller than prostomium. Notosetae consisting of paleae and spines. Paleae serrated on their margins, without hoods on middle and midline groups, dorsal surface moderately knobbed (Figs. 1C–F, 2B). Middle group paleae of midbody numbering 20–30; middle, symmetric paleae with eight or nine internal longitudinal ribs and conical tapered tips (Figs. 1C, 2C); lateral middle group paleae asymmetrical with tips directed to middle ones, with eight internal ribs (Fig. 1D); central paleae shorter than lateral paleae in middle group. Midline group paleae about seven, each with denticulated surface midrib (Fig. 1F). Lateral group paleae gradually more slender and smaller from the principal group to the anteriomedial spines (Fig. 1E). Three spines slender and denticulated in each parapodia on anterior group (Fig. 1G). Neuropodia with characteristic setae (Fig. 1H–J). Parapodial gland in the base of dorsal and ventral cirrostyles and in the inferior part of neuropodia (Fig. 1A–B).

Remarks.—Two very similar species with slender paleae have been previously described: *C. elegans* Bush, 1910 and *C.*

ehlersi Gravier, 1901. *Chrysopetalum elegans* differs from *C. ehlersi* in having well developed interramal glands with spindles of fibers, as well as in having wider neurosetal blades (Perkins 1985). The geographical distribution of these two species is also different: *C. elegans* has been reported from the Caribbean (Bermuda and Cuba), Gulf of Mexico, and Florida, whereas *C. ehlersi* has been reported from the Indian Ocean (Gulf of Aden, Persian Gulf and Kenia). *Chrysopetalum elegantoides* n. sp. from Coiba has cirrophoral glands but lacks interramal glands, although it is very similar to *C. elegans* in the shape of the paleae and the width of the neurosetae. The specimens from Coiba have been compared with specimens of *C. elegans* from Cuba (San Martín 1986). The specimens of *C. elegans* from Cuba have very conspicuous interramal glands, confirming that this character has value for segregating species (Perkins 1985). Comparisons have also been made with specimens of *C. ehlersi* 1941. Specimens from Kuwait and Mombasa are not *C. ehlersi*, and perhaps represent an undescribed species. They differ from *C. ehlersi* in having conspicuously broader hooded paleae, whereas the specimens from the Red Sea perfectly agree with the original description (Gravier 1901). *Chrysopetalum elegantoides* shares with *C. ehlersi* the absence of an interramal gland and the similar shape of acute paleae, but they differ in several features: the median antenna in *C. elegantoides* is shorter than those in the specimens of *C. ehlersi*; *C. elegantoides* has proportionally more slender paleae than does *C. ehlersi*, which is more evident in the middle group and the lateral group paleae (Figs. 1C, E, 3C, E); the tips of the paleae are sharper in *C. elegantoides* (Fig. 1D) than in those of *C. ehlersi* (Fig. 3D); midline group paleae have the denticulated midrib displaced laterally in *C. ehlersi* (Fig. 3F) and centered in *C. elegantoides* (Fig. 1F); the bidentation of neurosetae appears to be more pronounced in *C. elegantoides* (Figs. 1H–J, 2E, F) than in *C. ehlersi* (Fig.

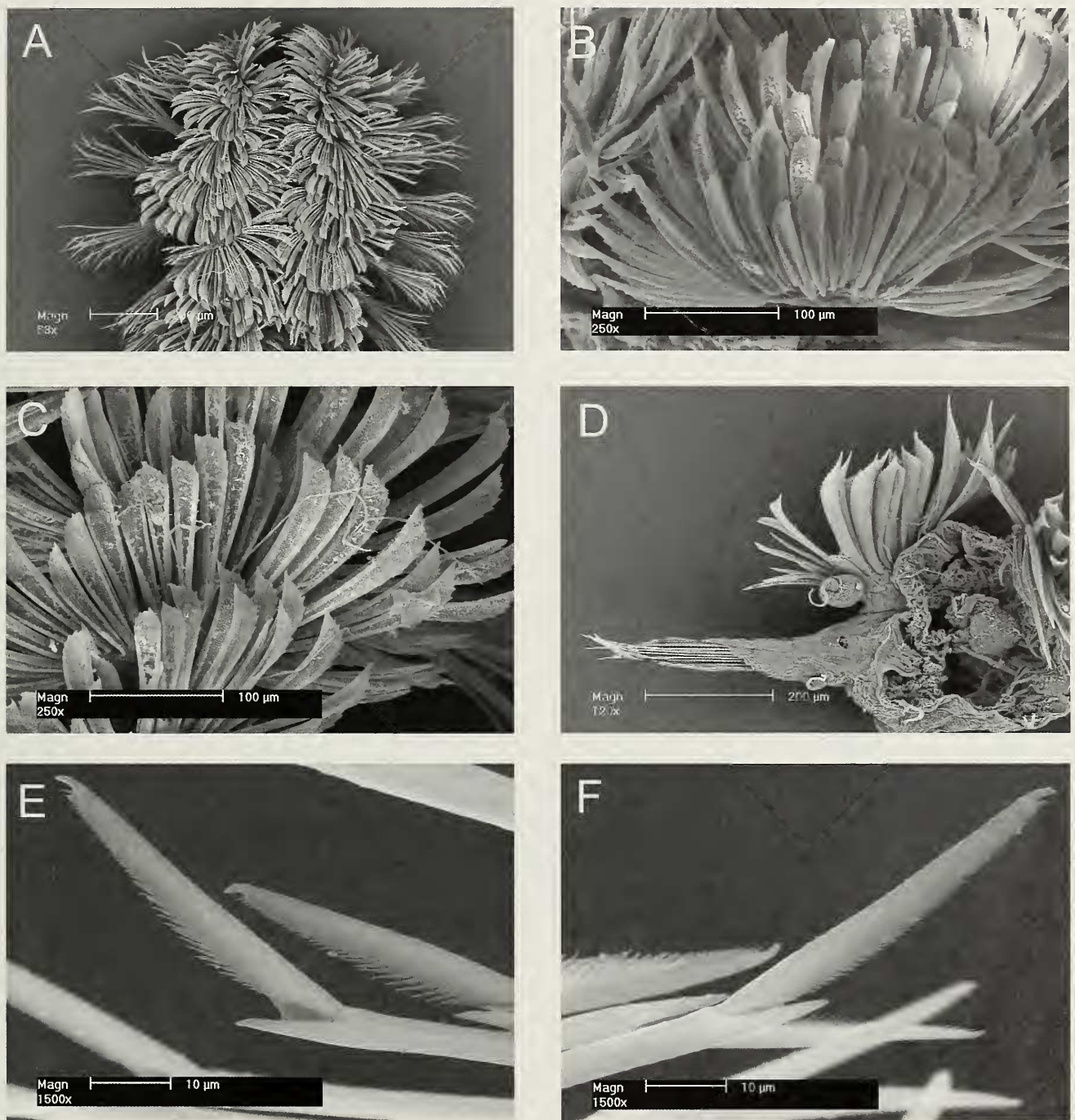


Fig. 2. *Chrysopetalum elegantoides* n. sp. Scanning electron micrographs (SEM). A: Anterior end, dorsal view; B: Paleae, anterior setigers; C: Paleae, middle setigers; D: Middle parapodium, posterior view; E–F: Compound falciger neurosetae.

3G–I); the neurosetal blades are shorter but they have the same width (they measure 44, 35 and 15 μm long in *C. elegantoides*, in the superior, median and inferior setae of a midbody parapodium respectively, and 57, 41 and 20 μm long in *C. ehlersi*, respectively). The cirrophoral gland is relatively larger in *C. elegantoides* than in *C. ehlersi* (Figs. 1A, B, 2D, 3A, B).

The presence of three pairs of eyes has

been reported before on other species: Bush (in Verrill 1900) found some specimens with six eyes in the syntypes of *C. elegans*, although Perkins (1985) reported only two pairs.

Etymology.—The specific name is given because of the similarity between this species and *C. elegans* (-oides = similar to, in Greek) which lives on the other side of the Isthmus of Panamá.

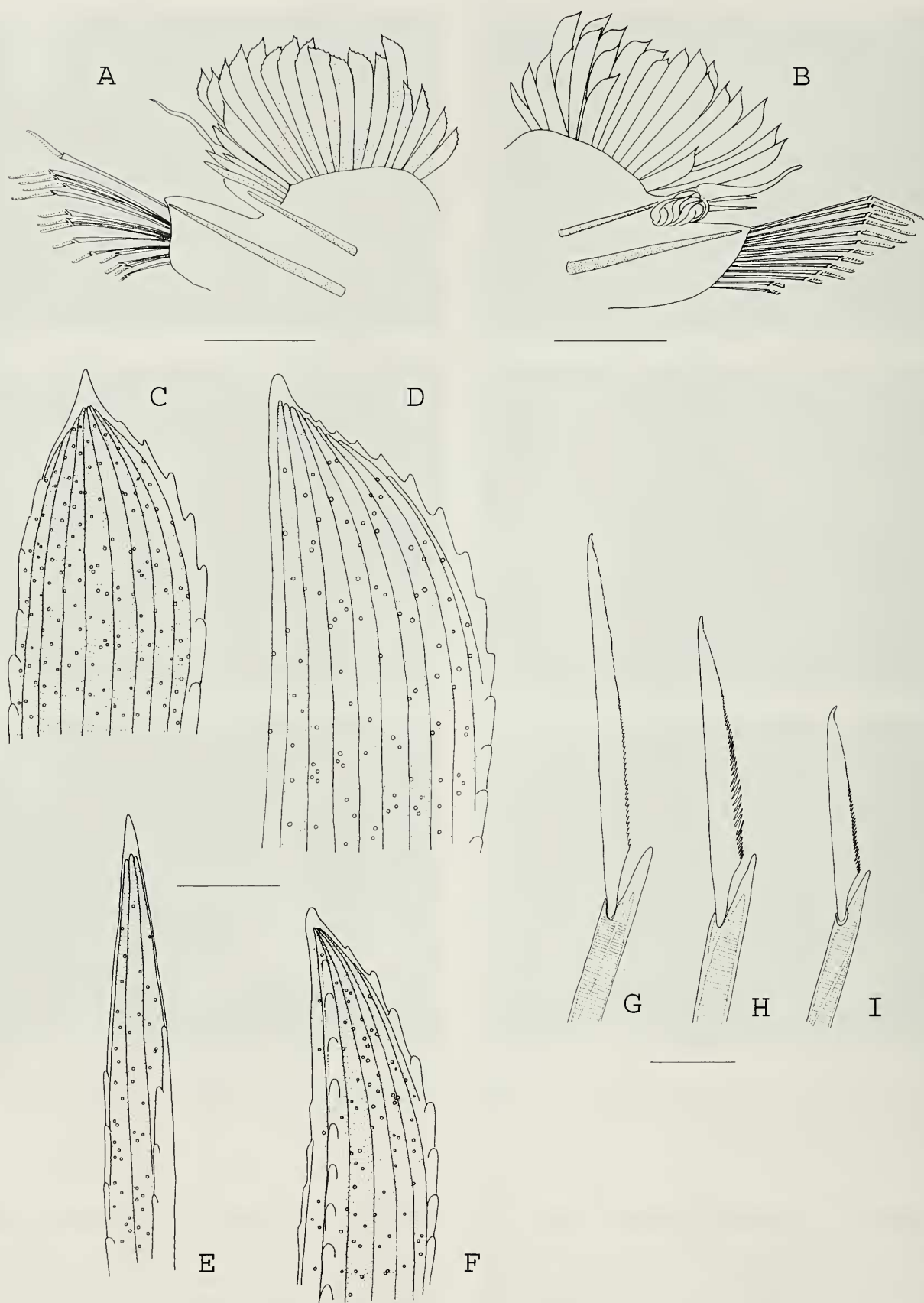


Fig. 3. *Chrysopetalum ehlersi*. NHML ZK 1941.4.4.238. A: Parapodium middle segment anterior view; B: Same, posterior view; C: Tip of palea, central part of middle group; D: Same, from lateral part; E: Palea, lateral group; F: Palea, midline group; G: Upper compound falcigerous neuroseta; H: Middle compound falciger; I: Lower compound falciger. Scale A, B: 0.195 mm; C-I: 20 μ m.

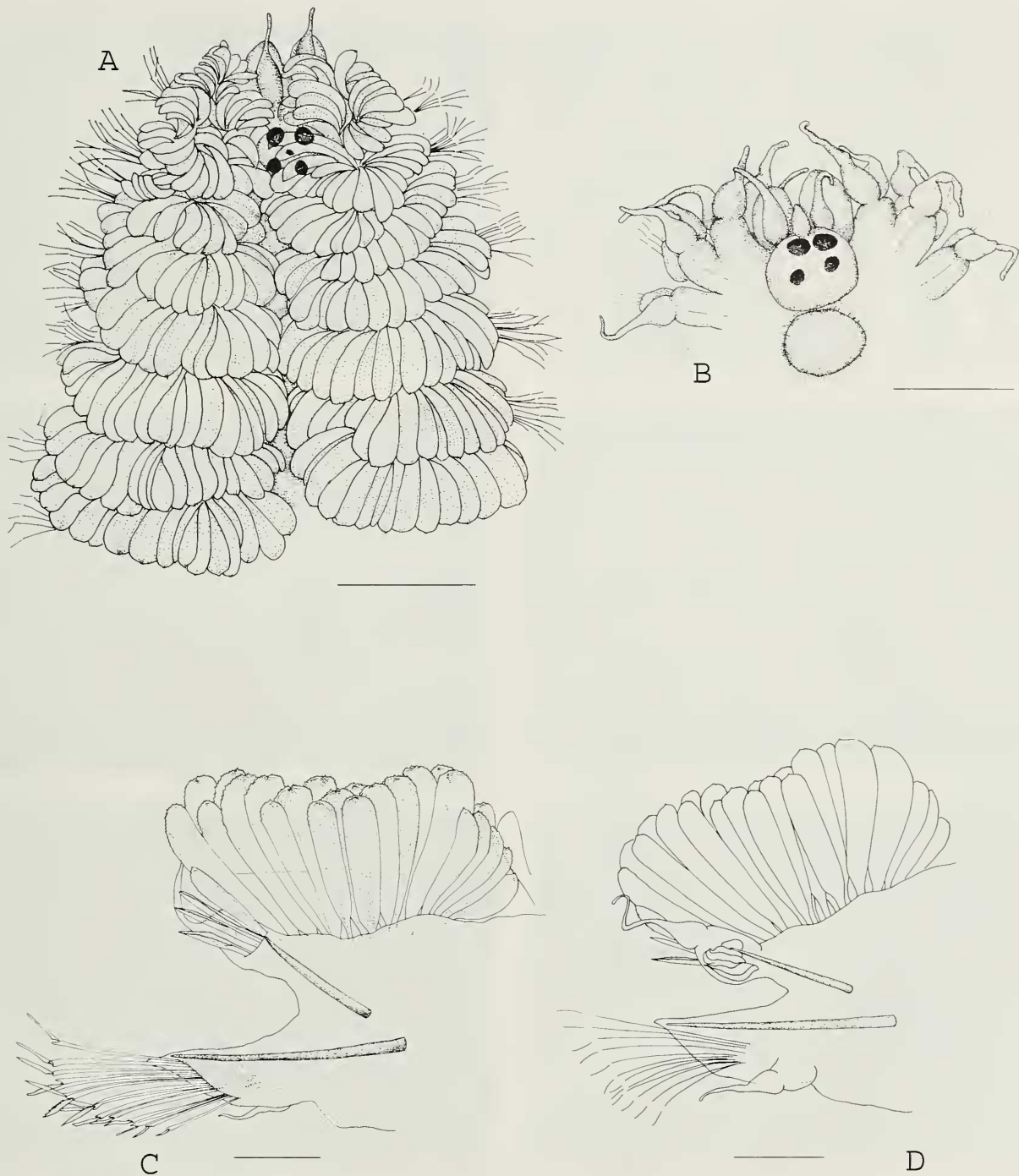


Fig. 4. *Chrysopetalum maculata* n. sp. AR1SEP98. A: Anterior end, dorsal view; B: Anterior end without paleae, dorsal view; C: Right parapodium, middle segment, anterior view; D: Left parapodium, middle segment, posterior view. Scale A: 0.195 mm; B: 0.18 mm; C, D: 97.5 μ m.

Habitat.—Blocks of dead *Pocillopora* spp.

Geographical distribution.—Pacific coast of Panamá.

***Chrysopetalum maculata*, new species**

Figs. 4–6

Material examined.—Holotype: AR1 SEP98(1) (MNCN 16.01/8530a), paratypes: AR1SEP98(3) (MNCN 16.01/8530b).

Additional material examined.—AR1SEP98(10).

Description.—Holotype anterior fragment 4.12 mm long, 1 mm wide without setae, 30 segments; largest paratype anterior fragment, 2.76 mm long, 0.8 wide, 23 segments. Fragile, broad body, white to pale brown. Silver to gold-colored paleae fans, often flecked with brown spots, covering worm completely, median paleae interlock-

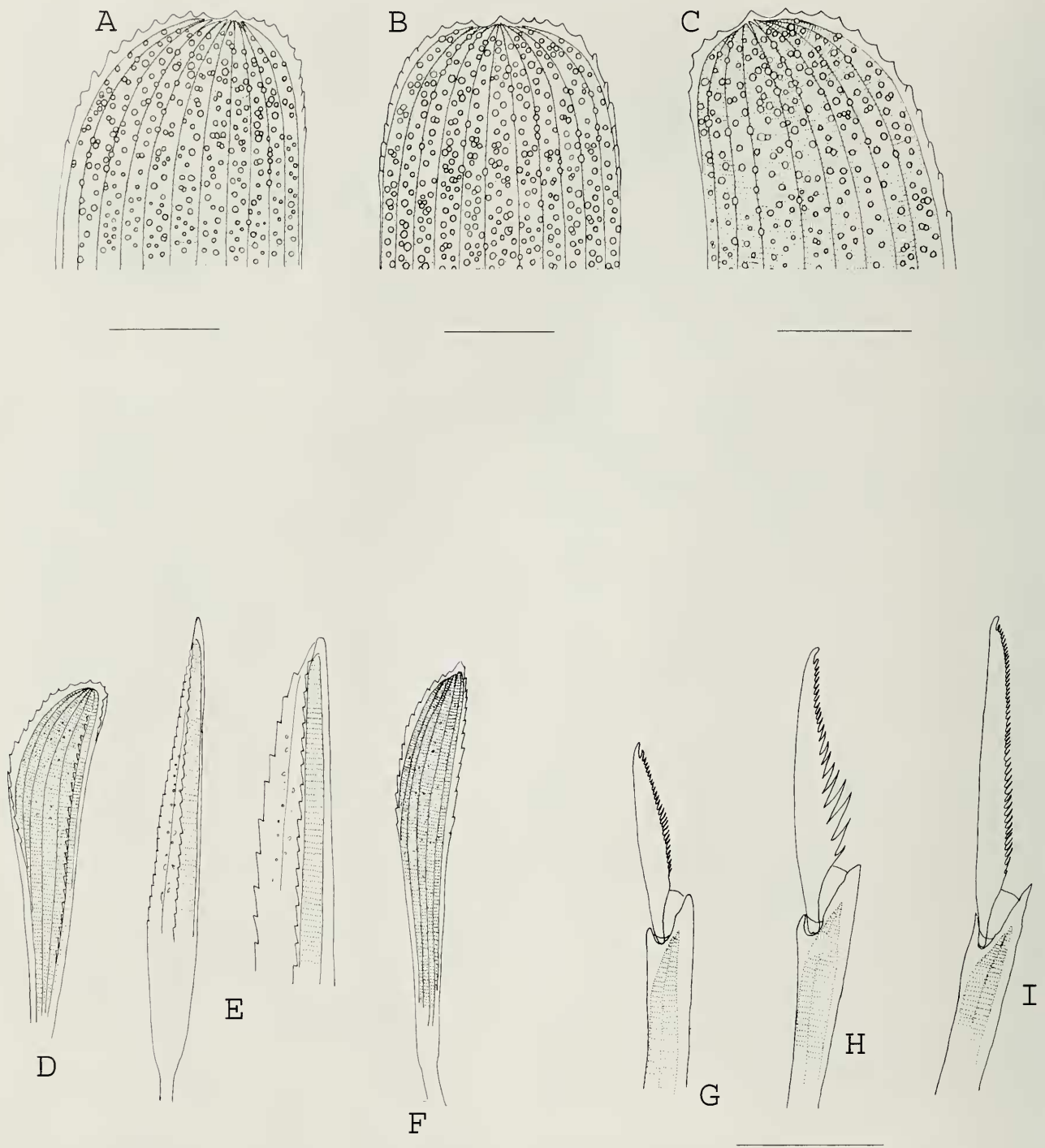


Fig. 5. *Chrysopetalum maculata* n. sp. AR1SEP98. A, C: Tips of paleae from lateral part of middle group, middle segment; B: Tip of palea from central part of middle group, middle segment; D: Palea, midline group; E: Paleae, lateral group; F: Palea, lateral group; G: Lower compound falciger neuroseta; H: Middle compound falciger; I: Upper compound falciger. Scale A-C: 20 μ m; D: 48 μ m; E: 20 μ m; F: 48 μ m; G-I: 20 μ m.

ing at mid-line, forming distinct convex median ridge (Fig. 4A). Prostomium wider than long, with two pairs of garnet eyes, some specimens with an additional central eye. Palps about twice longer than wide (Fig. 4B). Rounded caruncle with cilia (Fig. 6B). Mouth covering semioval (Fig. 6A), eversible proboscis with two stylets. Noto-

setae consisting of only very broad paleae, anterior group spines absent. Middle group paleae of middle segments about 20-22, with dorsal surface strongly knobbed, with 9-12 internal longitudinal ribs (Fig. 5A-C) and, sometimes, with hooded tips; various symmetrical paleae in the centre of the fan (Fig. 6D). Midline group bearing about five

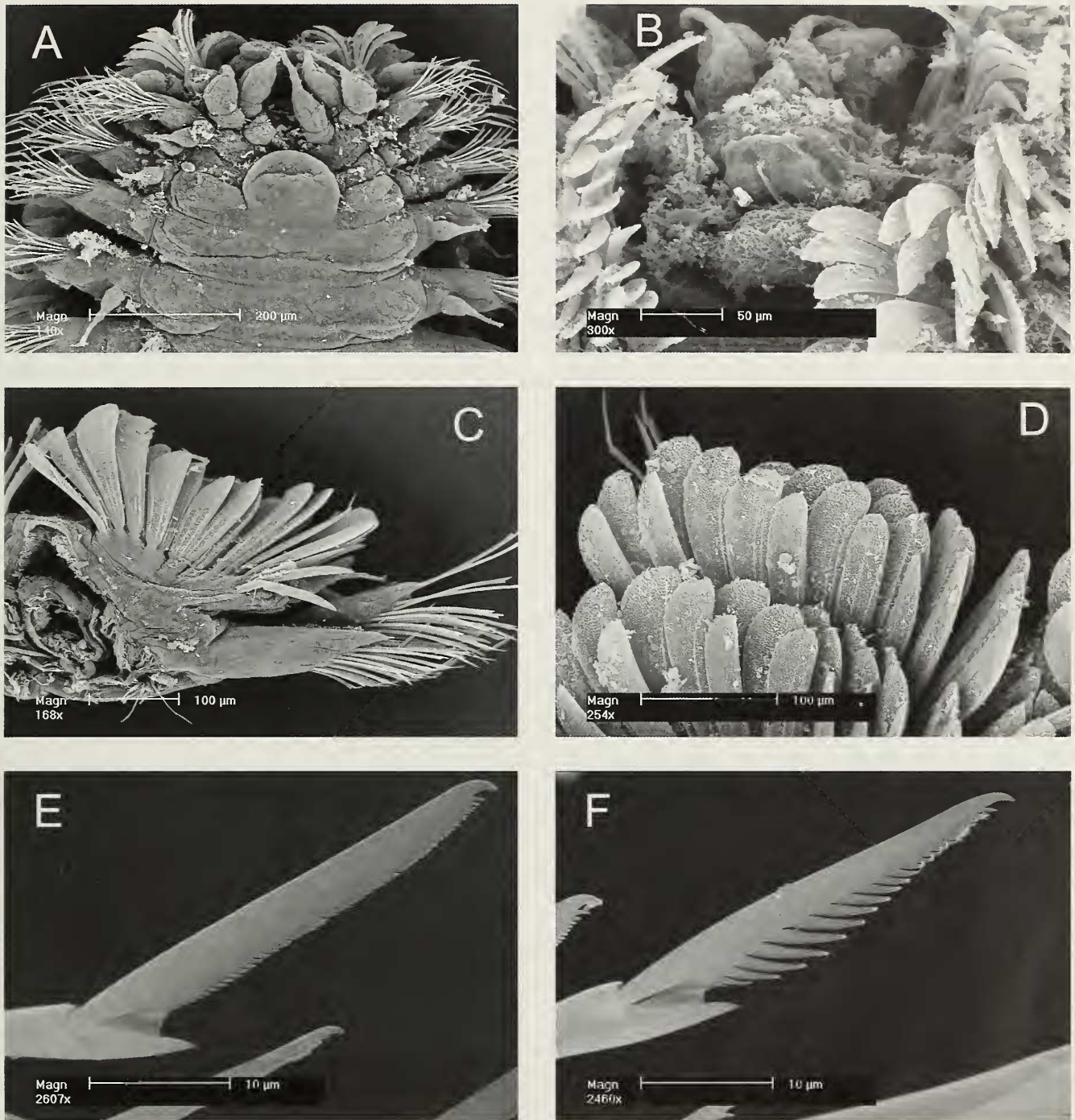


Fig. 6. *Chrysopetalum maculata* n. sp. AR1SEP98. (SEM). A: Anterior end, ventral view; B: Ciliated caruncula; C: Left parapodium, middle segment, anterior view; D: Tips of paleae from middle group, middle segment; E: Upper compound falciger neuroseta; F: Middle compound falciger neuroseta.

paleae with denticulate midrib and six longitudinal ribs (Fig. 5D). Lateral group consisting of one long, broad and acutely tipped palea with five or six longitudinal ribs, originating near acicula (Fig. 5F) and two or three more slender, shorter paleae originating laterally (Fig. 5E, 4C). Compound falcigerous neurosetae numbering 20 to 30 with blades moderately long. Upper few blades distinctly longer than adjacent

ones, gradually shorter ventrally. Dorsal blades 55 μm long, with short and coarse serration (Figs. 5I, 6E); middle blades 38 μm long, with long and stout serration (Figs. 5H, 6F); ventral blades 28 μm long, with fine, moderately long serration (Fig. 5G). Interramal region of middle parapodia ciliated on anterior side. Glands containing spindles of fibers in dorsal cirrophore (Fig. 4D).

Remarks.—*Chrysopetalum maculata* n. sp. resembles the general aspect of the species of the genus *Arichlidon* Russell, 1998, because of considerably broad shape of the body and paleae, as well as the golden color of the paleae with brown scale spots. However, the diagnostic characters place this species in the genus *Chrysopetalum*. *Chrysopetalum maculata* differs from other species of the genus in having very broad knobbed paleae and in lacking spines on the notopodia of middle segments. *Chrysopetalum remaneii* Perkins, 1985 and *C. hernancortezae* Perkins, 1985, have very narrow paleae and notopodial spines. *Chrysopetalum elegans* Bush, 1900 also possesses very narrow paleae and their typical interramal glands could not be observed in the studied specimens. *Chrysopetalum debile* (Grube, 1855), *C. occidentale* Johnson, 1897, *C. floridanum* Perkins, 1985, and *C. euripalea* Perkins, 1985, have also narrow paleae, and tips of the paleae are displaced and have notopodial spines. The definition of *C. elongatum* (Grube, 1856) is conflicting and not clear (Perkins 1985) since drawings and descriptions are incomplete. The most similar species is *C. heteropalea* Perkins, 1985, because both *C. maculata* and *C. heteropalea* lack notopodial spines, possess dorsal cirrophoral glands, the anterior side of middle parapodia in the interramal region is ciliated, and the shapes of neurosetae and paleae are similar. The tips of the paleae of *C. heteropalea* are also displaced as in *C. maculata* and both present symmetrical paleae in the centre of the middle group. Paleae of *C. heteropalea* are considerably narrower, with 8 longitudinal ribs and lack knobs in their dorsal surface; instead, there is ornamentation consisting of numerous and irregular transversals ribs that is not present in *C. maculata*. *Chrysopetalum heteropalea* has also visible glands in the neuropodia and ventral cirrophores, which have not currently been found in specimens of *C. maculata*. Neurosetae are similar in both species, although *C. maculata* does not present the typical lowest

compound falciger that occurs in *C. heteropalea* and middle compound falcigers are slightly different. The caruncle of *C. maculata* is ciliated, differing from that described by Perkins (1985) for *C. heteropalea*.

Etymology.—The species name derives from the latin *macula* (=spot), in reference to the numerous dark spots on the surface of paleae.

Habitat.—Intertidal coarse sand.

Geographical distribution.—Pacific coast of Panamá.

Chrysopetalum occidentale Johnson, 1897
Fig. 7

Chrysopetalum occidentale Johnson, 1897: 161, pl. 5, figs 15, 16, pl. 6, Figs. 17–19; Monro 1933a: 19; Hartman 1961: 56, 57; 1968: 185, 186, Figs. 1–5; Fauchald & Reimer 1975: 82; Fauchald 1977a: 71, Figs. 18 a–c; 1977b: 10, Perkins 1985: 869–871, Figs. 3, 4.

Material examined.—CM1 SEP98 (1+ 1 fragment), CUAL8FEB97 (1 fragment).

Remarks.—Only one anterior fragment of 15 setigers and two middle fragments were collected. The specimens agree generally with the description of Perkins (1985). The anterior fragment lacks the median and left antennae, and we can not compare these structures with Perkins' description (1985). Middle group paleae have obtuse tips and eight to ten internal ribs (Fig. 7C, D). Midline group paleae have the denticulated midrib slightly displaced laterally (Fig. 7F). Lateral group paleae are slender (Fig. 7E). Blades of compound falcigerous neurosetae are bidentate, gradually decreasing in size dorsally to ventrally (Fig. 7G, H).

Perkins (1985) established some differences between the specimens from California and those from Mexico. The number of paleae in the middle group of specimens from the first locality is between 35 and 40 and in Mexico they have a maximum of 30 paleae. In Coiba, the specimens found have

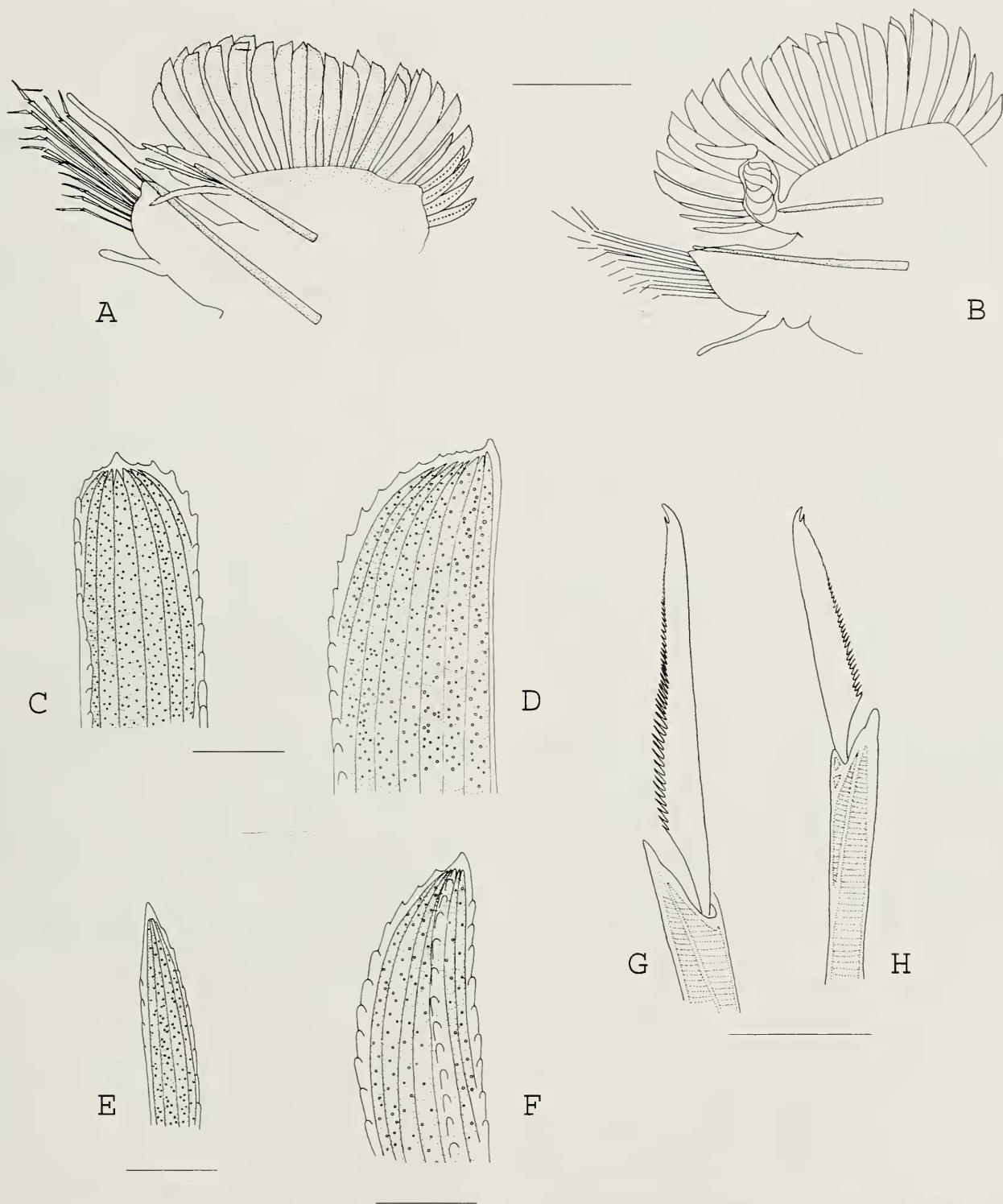


Fig. 7. *Chrysopetalum occidentale*. CM1SEP98. A: Left parapodium, setiger 14, anterior view; B: Right parapodium, same setiger, posterior view; C: Palea, middle group, central part; D: Palea, middle group, lateral part; E: Palea, lateral group; F: Palea, midline group; G: Upper compound falciger neuroseta; H: Lower compound falciger. Scale A, B: 0.195 mm; C-H: 20 μ m.

between 15 and 24 paleae in the middle group (Fig. 7A, B). Midline group paleae number about six in California and about four in Coiba.

Type locality.—California.

Habitat.—Rocks (Hartman 1968), hold-

fast (Perkins 1985), intertidal (Fauchald 1977a), dead coral (*Pocillopora* spp.).

Geographical distribution.—According to Perkins (1985) the distribution of this species is localized in the East Pacific, from the southern California to Panamá.

Key to *Chrysopetalum* Species in the
Panamanian Pacific

- 1a. Anterior group of paleae and spines
(*sensu* Perkins 1985) absent. Body and
paleae very broad. *C. maculata* n. sp.
- 1b. Anterior group of paleae and spines
present 2
- 2a. Middle group paleae with acute tips
(see Fig. 2C–F), and narrow subtermi-
nal region, without hoods or remnants
in the distal end of paleae
. *C. elegantoides* n. sp.
- 2b. Middle group paleae with obtuse tips
(see Fig. 8C–F) and enlarged subtermi-
nal region, hoods or remnants gener-
ally present *C. occidentale*

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